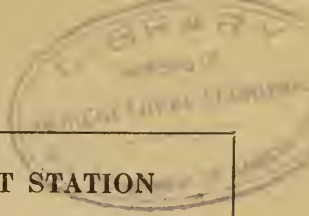


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HAWAII AGRICULTURAL EXPERIMENT STATION

HONOLULU, HAWAII

**Under the supervision of the
UNITED STATES DEPARTMENT OF AGRICULTURE**

**REPORT OF THE
HAWAII AGRICULTURAL EXPERIMENT
STATION**

1928



Issued June, 1929



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HAWAII AGRICULTURAL EXPERIMENT STATION, HONOLULU

[Under the supervision of the Office of Experiment Stations, United States Department of Agriculture]

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HAWAII AGRICULTURAL EXPERIMENT STATION HONOLULU, HAWAII

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Washington, D. C.

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SUMMARY OF INVESTIGATIONS

By J. M. WESTGATE, *Director*

During the year covered by this report the work of the station was much the same as in previous years. Considerable attention was given to such crops as edible canna, coffee, and the Macadamia nut, all of which promise to become important agriculturally as the problems of production and marketing are solved. Attention was also given to the development of agricultural investigations dealing with tropical research.

Work of the horticultural division was devoted largely to the development of improved methods of budding and grafting tropical fruit and nut trees and to determining their cultural requirements. New varieties of various species were introduced and improved strains were developed largely by selective breeding. Comparative tests were made of these new and improved forms and the standard varieties. The horticulturist gave a number of demonstrations in budding and grafting for the benefit of students of the public schools and adults, and he served as chairman of the committee on fruit

exhibits at the two Territorial fairs which were held during the fiscal year. He also acted as one of the judges of the Star-Bulletin school-garden contests and distributed approximately 32,500 plants of new and improved kinds of tropical and subtropical fruits and nuts to applicants on the various islands and on the mainland.

Agronomic work was directed principally toward the development of root crops for human consumption, the production of feed for livestock and of starch, the development of the ginger industry, and the breeding of improved varieties of corn and lettuce. Experiments were continued with grasses which are promising especially as a feed for dairy cattle. Experiments were also made with various aquatic food plants and with other vegetable and food plants of oriental origin. Varietal studies were begun with sweet clover, pigeon peas, watermelons, and muskmelons. A manuscript describing a number of oriental vegetables grown in Hawaii was submitted for publication. Small lots of seed and other propagating material were given to numerous homesteaders to enable them to obtain a start of the various improved species and varieties of food and forage plants. The agronomist served as chairman of the poultry committee of both the sixth annual Territorial fair, held from August 29 to September 5, 1927, and of the seventh annual Territorial fair, held from April 30 to May 5, 1928. He continued to assist local poultrymen in the numerous problems connected with the industry.

The work of the chemical division dealt principally with the solution of problems arising in connection with the development of the edible-canna starch industry. Cultural, variety, and milling tests and studies to learn the relative effect of different field treatments and methods of harvesting on the properties of the resulting starch were made. Studies were begun dealing with the physical properties of tropical soils of volcanic origin, particularly with respect to the nature and properties of their colloids. Analyses of 56 Orient-grown vegetables in Hawaii were made, and the results submitted for publication in a bulletin in cooperation with the agronomy division.

The extension agent for the island of Hawaii again assisted individual small farmers by giving them information concerning production and marketing problems and also by endeavoring to develop new crop industries and to extend the culture and yields of minor established crops, including coffee. He also materially assisted with the boys' and girls' club work and served as a judge in the home and school garden contests and of the exhibits at the various school and Territorial fairs. During the year he traveled approximately 9,000 miles by automobile and 400 miles by boat in the interest of farmers living in different parts of the island.

Activities in the boys' and girls' 4-H clubs, including food-preservation clubs, bread-making clubs, cooking clubs, clothing clubs, garden clubs, pig clubs, poultry clubs, rabbit clubs, and horticultural clubs were carried out along the same lines as in previous years. A total of 1,209 children enrolled, and approximately 60 per cent of the members completed their projects. At the various local and Territorial fairs excellent facilities were provided for the display of club exhibits. These exhibits serve to acquaint the public with the value of such fields of endeavor.

At the Haleakala demonstration farm numerous tests were made to indicate the combination of crops and the kind of agricultural practices that are best adapted to sections comparable with the district in which the farm is located. During the year 170 varieties of 70 different kinds of crops or crop groups were under test and observation. Planting material of the most desirable varieties was furnished to farmers who desire to establish them on their farms. The superintendent assisted with the boys' and girls' 4-H club work and with the agricultural projects of the Maui County Chamber of Commerce, of which he is an active member.

REPORT OF THE HORTICULTURAL DIVISION

By W. T. POPE

The horticultural work for the fiscal year 1928 was of three general classes: (1) Plant introductions and distributions, and cultural requirements of tropical fruits and nuts; (2) investigations of the best methods of propagating tropical and subtropical fruit and nut trees; and (3) a study of varieties and habits of pollination of avocados, papayas, bananas, and tomatoes. The larger experiments dealt with the cultivation of the mango, avocado, Macadamia nut, date, breadfruit, papaya, and coffee, which are small industries or give promise of becoming such.

MANGOES

In the work with mangoes, studies were made of vegetative methods of propagating the tree, its cultural requirements, and the varieties found growing in the Territory. The problem of vegetative propagation is of considerable concern to anyone contemplating the establishment of commercial orchards.

Grafting experiments with mango nursery stock were continued not only to verify the results of the methods formerly tried, but also to increase the stock of propagating material of certain new varieties. Several forms of grafting were tried, including wedge grafts, whip grafts, and side-tongue grafts, each of which gave a reasonable amount of success. The side-tongue method, however, gave the largest percentage of successful grafts, as was the case during the two previous seasons. (Fig. 1.)

Experiments to learn the cultural requirements of the tree have been carried on at the central station, in one commercial orchard, and also in a number of privately owned gardens in various parts of the Territory. The two small mango orchards at the central station have been of value for furnishing considerable data on the cultural requirements of the tree and for making varietal studies, and also have been a source of good propagating material. The older orchard was set largely about 19 years ago and contains 68 trees representing 21 varieties. These were propagated in the early vegetative mango experiments and consisted of inarches and buds. The young mango orchard occupies about two-thirds of an acre plat and contains 43 trees, representing mostly grafted trees of varieties selected for certain qualities of fruit, such as resistance to fruit-fly attacks. This orchard is now in its fourth year and has displayed some fine examples of both the habits of growth and early produc-

tiveness of certain mango varieties. (Fig. 2.) Both orchards were cultivated during the year, and for a period the older orchard contained a cover crop of cowpeas. As a precautionary measure against the attacks of mango blight (*Glæosporium mangiferae*), the trees of both orchards were sprayed with Bordeaux mixture twice during the two weeks previous to the opening of the blossoms. The season was very favorable for the development of the fruit, the rainy season closing just before the blossoms appeared and being followed by warm weather and trade-wind breezes. The mango crop throughout the Territory is very large this season, and the fruit is of good quality.

The varietal studies included not only varieties that were introduced or developed by the station, but also those that have been brought to the attention of the station from all parts of the Territory. The characters for determining desirability are flavor, texture, color, and size of fruit, general marketing qualities, yield, and particularly resistance to the attacks of insect pests and fungus diseases. During the year a manuscript on mango culture in Hawaii was submitted for publication. Among the new varieties obtained during the year were the Whelan (station accession No. 5281), Ono (accession No. 5322), McDougal (accession No.



FIGURE 1.—Three forms of graft unions employed successfully in grafting the mango and the avocado at the station

5280), Ludwig (accession No. 5298), and Bishop (accession No. 5247). The latter, as a small inarched tree, was introduced from Tahiti by G. P. Wilder. It has just fruited and has proved to be of very high quality. (Fig. 3.)

AVOCADOS

The development of improved methods of vegetative propagation of good varieties is the most important problem of avocado growers in Hawaii. Very excellent varieties have been developed, and new ones have been brought into the Territory, but as yet local markets rarely have any of the choice fruits for sale. During the year ex-

periments in grafting were given considerable attention. The side-tongue method of grafting 8-month-old seedlings gave about 48 per cent of successful grafts. The method of wedge grafting very young seedlings, ranging from 40 to 60 days old, was fairly satisfactory, but this season it proved difficult to obtain the young scion wood of good varieties at the time the young seedlings were ready for grafting. The means now employed to increase good varieties more rapidly is

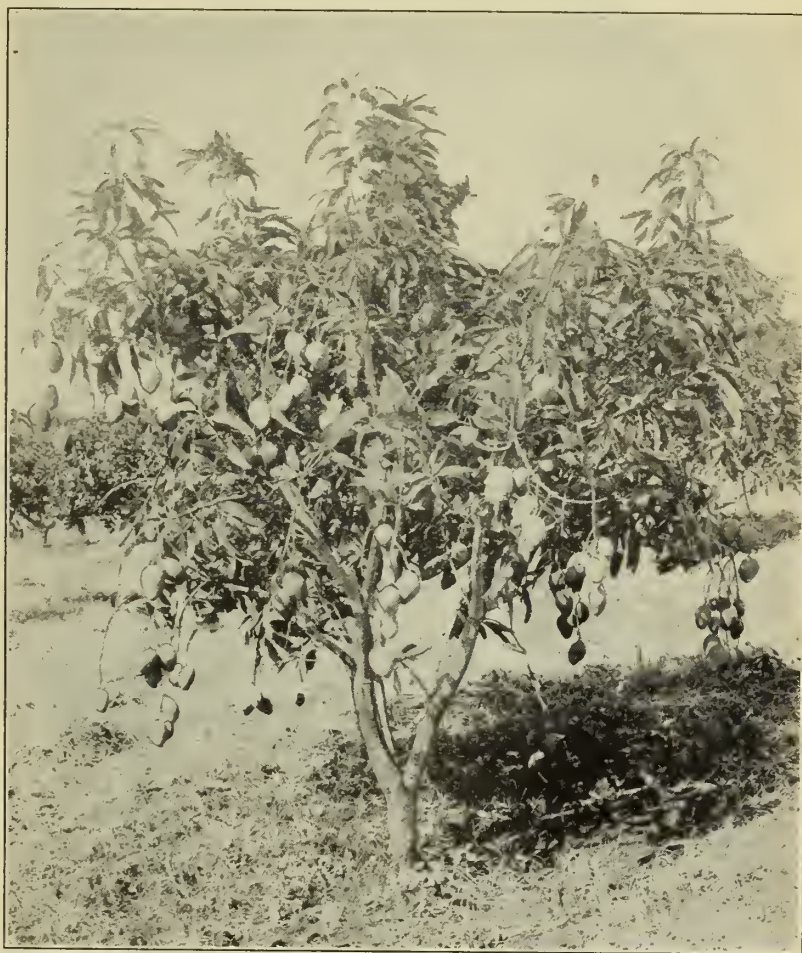


FIGURE 2.—Lewis mango, 4½ years old, maturing 184 fruits. Hawaii station orchard

through a limited number of carefully located cooperative orchard projects. The station, as its part in the work, furnishes enough grafted trees to set an acre of land or fraction thereof, and supervises the culture; the cooperating orchardist furnishes the land, the implements, and the labor. The only compensation exacted by the station is the privilege of entering the orchard at any time for observation and study and of removing a reasonable amount of propagating material in season as may be desired.

The station orchard, containing mostly Guatemalan varieties, is located in the Tantalus substation on Mount Tantalus, where the elevation is about 1,000 feet. The past winter months were rainy.



FIGURE 3.—Bishop mango. Introduced into Hawaii from Papeete, Tahiti, December 16, 1926, by G. P. Wilder. Photographed June 15, 1928

and the spring was warm and otherwise favorable for natural growth and blossom development. Some time was given to pollination study. Under favorable conditions the fruit sets uniformly on practically

all the trees. Trees of certain varieties which have the reputation of being light yielders are still carrying a good crop of young fruits. Varietal studies were in progress during the year.

MACADAMIA NUT

A study of the variations of the Macadamia nut tree was made during the year. Considerable range of differences was noted in the fruit, foliage, and habits of growth of the seedling trees. What is known in some countries as the "common Queensland nut" (*Macadamia ternifolia*) is commonly found in this Territory. Normally the tree is tall, with upright branches and dark-green foliage. The leaves are often a foot long and arranged in whorls of three or four at the nodes. The leaf blades are without petioles, and the margins are wavy and serrated with prickles. The nuts are usually borne in clusters of 12 or more on a single axis. The surface of the hard shell varies from undulating to bumpy. Another type, known botanically as *M. ternifolia* var. *integrifolia*, is smaller and of more spreading habit, with leaves in clusters of three at the nodes, each having a one-half-inch petiole. The blades are spatulate, rarely more than 6 inches long, and the margins are without prickles or nearly so. Most of the flowers of each panicle fall away, leaving only one to three nuts to grow to maturity. (Fig. 4.)

In the groves studied there are many variations ranging between the above-mentioned types. Occasionally a tree will be found bearing both spiny-edged and smooth-edged leaves; some trees will produce oblong nuts with a deeply wrinkled husk and apex that is considerably extended. Occasionally a tree is found bearing two nuts in one husk, each nut having a hemispherical shape. Trees have been found with all the nuts of this undesirable shape. Another unsatisfactory habit not uncommonly found is the failure of trees to fruit at all. Variation in the quality of the nuts is also a common occurrence. These differences are not unlike those of seedlings of many other kinds of fruit and nut trees. Vegetative methods of propagation will have to be practiced before Macadamia nut culture can be expected to become an industry of any considerable consequence.

This year a number of propagating experiments were in progress. Trials were made with both seeds and vegetative methods. From results with the former it is concluded that seedlings may be easily produced by planting selected fresh seeds immediately following full maturity. At the station a propagating bed of coral sand about a foot deep has proved to be very satisfactory. Nuts which are planted 4 inches deep and kept moist usually germinate and produce shoots with active foliage in about 30 days. Very shortly after this the seedlings may be transplanted to gallon tin containers or 8-inch pots. Vegetative methods of propagating the Macadamia nut tree have proved to be more difficult. A number of methods were employed. Branch and root cuttings of different forms were tried in different mediums without satisfactory results; air layering, inarching, and various other forms of grafting proved to be more hopeful, especially side-tongue grafting and whip grafting. These grafts were successful when seedling stocks nearly a year old, growing in gallon tin containers, were used. Side-tongue grafts and whip grafts when well made and the union, including the entire scion, coated with

paraffin, succeeded with little difficulty. It is believed that this method, with possibly some improvement, may be utilized in standardizing a good variety which will mean much toward developing the Macadamia industry in Hawaii.



FIGURE 4.—*Macadamia ternifolia* var. *integrifolia*. Foliage, flower, and fruit, showing the characters of the variety

DATES

Investigations to learn the possibilities of developing a commercial date industry in Hawaii were made during the year. There is considerable local interest in date growing. Choice dates are pro-

duced in various parts of the Territory. Unusually fine specimens of the fruit were exhibited at the Territorial fair, which was held from August 29 to September 5, 1927. During the fall several seedling trees of the Deglet Noor variety were in bearing at the Girls' Industrial School, Honolulu. Date seeds of 10 varieties introduced last year produced 425 seedling trees, which are being placed in cooperative experiments with carefully selected growers. One lot of 100 trees, 10 of each variety, was located with L. Faye, of Kekaha, Kauai. These trees were delivered in December, 1927. This grove is in an unusually warm locality on low, silt-formed soil approximately one-eighth mile from the sea. The land is high enough for good under-drainage and is watered by a good irrigation system in which mountain water is used.

In another cooperative experiment which was arranged with E. P. Fogarty, of Waianae, Oahu, 80 seedlings, representing 5 varieties, were planted on low land 1 mile from the sea. It is hoped to arrange for two other cooperative experiments in other parts of the Territory where conditions are believed to be favorable for date growing. Date palms, particularly young seedlings, have been attacked by a fungus (*Graphiola phœnicis*) which develops on the foliage in numerous pustules having the appearance of yellowish-white crumbs. The fungus is common on the date palms of many countries and is not considered to be serious in Hawaii.

BREADFRUIT

The breadfruit experimental work included studies to determine the best methods of propagating the tree and studies of the introduced varieties. During the year a number of root cuttings of varieties from the South Sea Islands were collected by G. P. Wilder and sent to the station for trial in a cooperative experiment. The material was assembled at Papeete, Tahiti, from different islands in that part of the Pacific and made the long journey to Honolulu via San Francisco. In some cases the roots were out of soil for a period of 38 days. Some, no doubt, were collected at a season when the cuttings could not withstand shipment. Consequently the percentage of cuttings that sprouted was very small. Including the introductions of previous years, about 50 South Sea Islands' varieties have been received to date for trial. Owing to difficulties experienced in rooting the cuttings, less than half of the varieties are established. Some of the trees of the earlier introductions are now large enough to furnish cuttings from the branches, and a trial of rooting these has given about 26 per cent of successful results. The results of the early experiments of propagating root cuttings of seedless breadfruit of the Hawaiian variety, conducted in 1922-23 and in 1923-24, indicated that these cuttings are the most successful when they are collected during the dormant period of the tree, preferably just before or at the beginning of the revival of annual growth. The dormant period usually continues for two or three months each year, beginning immediately after ripening of the crop. The root cuttings must be handled with care and not allowed to become dry at any time. They can not be suitably packed to withstand long distance shipments, and quarantine regulations do not permit them

to be brought into the Territory in soil. Seedless breadfruit trees which were developed from root cuttings collected in Tonga, Samoa, and Tahiti four and five years ago are now growing in various places in the Territory. Most of these trees have made remarkable growth



FIGURE 5.—Tutou seedless breadfruit tree, 3 years old. Introduced as a root cutting from Tahiti and propagated at the station. Tree growing at Mokuleia, Oahu

and are a source of material for varietal study. Several of the trees that were set out at Mokuleia, Oahu, are beginning to fruit. (Fig. 5.) Several trees of the Maopo variety are growing at the station. This variety is excellent for its fruit and for ornamental purposes. (Fig. 6.)

PAPAYAS

A total of 404 papaya trees occupying a little less than two-thirds of an acre plat is under trial at the station. Fields C-II and C-III contain 214 trees, set in 1926, representing six types according to nature of fruit or place whence the seeds were obtained. The stami-



FIGURE 6.—Maopo breadfruit tree from Tonga Islands. Introduced as a root cutting and now growing at the station

nate-flowered kinds constitute less than 10 per cent among the dioecious types, and the sterile or nearly sterile trees constitute about 15 per cent among the monoecious types.³ The two rows of Solo papaya trees have not proved to be satisfactory. The fruit has not

³ Sterility among the unsettled sex forms of different kinds usually appearing in the monoecious types is described in the following publication: HIGGINS, J. E., and HOLT, V. S. THE PAPAYA IN HAWAII. Hawaii Agr. Expt. Sta. Bul. 32, 44 p., illus. 1914.

been uniform and has in some instances been of entirely different shape from that usually produced by this strain of papaya.

The small grove in field A-III containing 190 trees representing a number of kinds was set in December, 1927, for a sex test. Of the monœcious, long-fruited kinds, the planting contains 15 trees of station accession No. 5313 from Africa, 13 trees of No. 5309, 19 trees of No. 5314, 19 trees of No. 5312, and 12 trees of No. 5311; and of the diœcious, round-fruited kinds, 15 trees of No. 5306, 14 trees of No. 5315, 11 trees of No. 5316, 14 trees of No. 5308 (seed from apex of fruit), 11 trees of No. 5206 from Panama, 6 trees of No. 5208 from Singapore, 4 trees of No. 5289 from Malaya, 14 trees of No. 5307, 7 trees of No. 5200, designated "he's," 6 trees of No. 5201, designated "she's"; and of the Solo variety, 10 trees.

During May and June, 1928, these trees began to blossom. Nearly all the monœcious type were in blossom by June 30. They show about the usual sex variations found in a grove of this kind. In the diœcious type the staminate trees number a little more than 50 per cent. Station accessions Nos. 5200 and 5201, received by mail from Tahiti, Society Islands, last year, were germinated in the fall and the young seedlings transplanted to the field in December, 1927. The lot of 20 seeds of each variety had been selected by a man from Anam who claimed that he could determine the sex of the future trees by the appearance of the individual seeds. He separated the seeds into two groups, which he designated as "he's" and "she's." From the "he's" seven trees were grown, six of which are staminate or males; one has not yet blossomed. From the "she's" six trees were grown, four of which are males and two females.

COFFEE

The coffee investigations were devoted, in part, to field studies of the present methods of culture, soil characters, and handling requirements. The main portion of the work was carried on in the coffee-growing section of Kona, Hawaii, during August and January of the present fiscal year. Coffee raising is carried on mainly by private growers, each of whom cultivates a small grove and handles his own crop in the manner that he deems best. Little attempt is made to learn what is being done to improve the crop in other coffee-growing countries. The work with the crop includes picking the ripe berries, a complicated process of pulping, and a system of sun drying the seeds for a considerable period without interference from dampness. Soil characters also are of importance. The coffee district of the island of Hawaii lies on the slopes of two great volcanic mountains. These slopes are composed of lava flows varying in age from the ancient to the more recent. The flows also vary greatly in composition and nature of formation, but in general are classed locally as "a-a" flows and "pahoehoe" flows. The former consists of broken up, clinkerlike lava which, when there is abundant rain, rapidly decomposes into a deep soil that is favorable for coffee-tree growth; the pahoehoe flows form great rolls of hardened lava which slowly disintegrates and often carries a shallow surface soil that is unsuitable for coffee culture.

About 800 trees of *Coffea arabica* have been grown at the station. This nursery stock is 18 months old and ready for budding and grafting experiments and for cooperative cultural tests. It is planned to test the effect of several different kinds of fertilizers on yield of coffee and to use the field for experiments in improving Hawaii coffee through hybridization with other species. Budding and grafting experiments with coffee were begun. Through the Office of Foreign Plant Introduction, United States Department of Agriculture, about 70 coffee seedlings of three species, *Coffea arabica*, *C. excelsa*, and *C. robusta*, were recently obtained from another part of the world.

MISCELLANEOUS NOTES

Minor work was done with figs, tomatoes, strawberries, mountain apples, annonas, pecans, chestnuts, bananas, watermelons, grapes, guavas, citrus, litchi, cashew, pomegranates, roselle, sapodillas, star apples, rubber, and fiber plants. Plants of several varieties of grapes were added to those already under test. A number of seedlings of cherimoya and also of the litchi were successfully grafted. The production of both the cherimoya and the litchi offer possibilities of becoming small industries. The mountain apple which responds to good culture is very much in demand locally. The citrus orchard received the usual amount of care and has proved to be a convenient source of graft wood.

Approximately 88 new accessions of plants and propagating material were received. Among the more important additions were grape plants of the varieties Isabella Regia, Gros Guillaume, and Olivette Blanche from California; *Garcinia berthami* from the Bureau of Agriculture of Manila, P. I.; seeds of cacao from the Division of Agriculture, Apia, Samoa; a new variety of mango, and propagating material of a number of varieties of seedless breadfruit from Papeete, Tahiti, Society Islands.

The horticultural department responded to numerous requests for horticultural information from growers and visitors to the station. Exhibits were prepared for two Territorial fairs, held from August 29 to September 5, 1927, and from April 30 to May 5, 1928. Twenty-one horticultural demonstrations were given during the year and 60 hours devoted to work in the classroom at the summer session of the University of Hawaii, in July, 1927. The horticulturist also acted as judge in one school-garden contest, made three trips to each of the 22 public-school gardens on Oahu in the spring of 1928, distributed numerous fruit plants and propagating material from the station nursery and orchards, and twice inspected six cooperative experiments during the year.

REPORT OF THE AGRONOMY DIVISION

By H. L. CHUNG

GINGER

In October, 1927, a survey was made of the ginger situation on the island of Maui to determine the area now devoted to the crop and the possibilities of extending it. The area was found not to exceed 2 acres. Private gardeners have small patches of ginger, none of

which exceeds 2,500 square feet in area. Only a sufficient amount of ginger is grown to meet demands on Maui. The Maui gardeners are willing to extend the area in ginger upon being guaranteed from Honolulu or elsewhere that the surplus will be absorbed. A cultural and fertilizer test was made at the station field N with two different varieties of ginger. Enough propagating material has been obtained to permit enlargement of the ginger project during the coming year. In a study of the quantity of fresh ginger annually imported into the United States of America, a total of 4,951,657 pounds of ginger was found to be recorded for 1926. Of this quantity, New York received 4,633,120 pounds and California 318,537 pounds.

SWEET POTATOES

Approximately 146 sweet-potato hybrids, chance seedlings, and standard varieties were tested during the year to determine their relative merits. These were planted in short cycles of three months each as a means of checking the activities of the sweet-potato weevil. Of the varieties tested, 1 produced at the rate of over 46,000 pounds

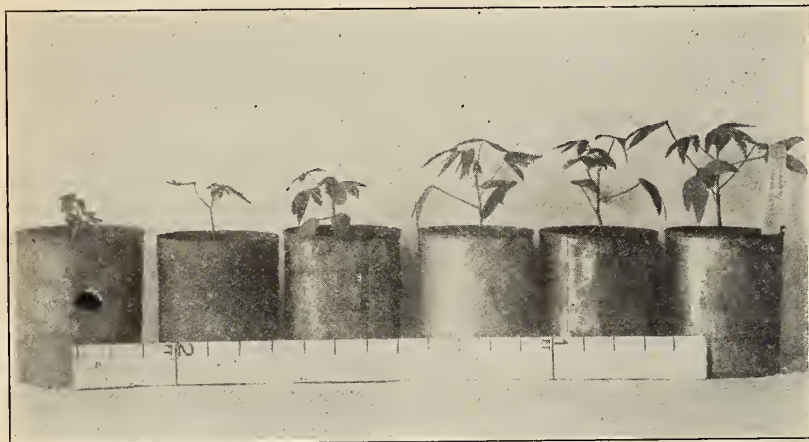


FIGURE 7.—Cassava seedlings 67 days old

of tubers per acre, based on the yield of 8 hills, 5 produced over 35,000 pounds, 7 over 30,000 pounds, 13 over 25,000 pounds, 29 over 20,000 pounds, and 23 over 15,000 pounds. These yields were obtained from a comparatively few hills of each lot (6 to 30), which, however, were grown 2 feet apart in 3-foot rows. The rows were grouped to simulate field conditions. From these productive varieties propagating material has been made available to local sweet-potato growers desiring to grow heavy-yielding varieties.

CASSAVA

A large number of the cassava varieties flowered and seeded freely. From the matured seeds a number of seedlings were obtained for use in comparative tests. (Fig. 7.)

TARO

Seventeen wet-land and twelve dry-land varieties of taro were grown. The former group, containing many Hawaiian varieties, was

cultivated chiefly to determine yields and to learn, if possible, their true native names. In the dry-land group a study was made to determine the best yielding varieties for dry-land conditions and to improve their productive qualities by selective breeding.

In connection with the wet-land variety culture, lime was applied to one of the plats to permit a preliminary study of the effect on taro rot.

CORN

During the early part of the fiscal year a study of the variation of the station hybrid sweet corn was made. Three distinct strains were obtained. Each was segregated according to the color of the silk. The selected ears of each strain were planted in order that their yielding qualities and their resistance to attacks by insect pests and diseases might be noted.

Further selection was made of the white and yellow Guam hybrids and the Cuban Red corn. Selected seed from the 1927 crop was planted in January to improve further these varieties by selective breeding.

RICE BORER

In February, 1928, the agronomist called the attention of the Territorial entomologists to the fact that certain local rice fields were infested with a rice borer (*Chilo simplex*). (Fig. 8.) This pest threatens to become a serious menace to the local rice industry unless its ravages are checked. At present (June 30, 1928) the pest is confined to leeward Oahu.

FORAGE GRASSES

The established plats of cultivated grasses were again maintained at the trial grounds. Seeds and cuttings from the area were distributed to ranchmen and to dairymen.

ALFALFA

A variety of alfalfa of apparently unknown origin was grown during the early part of February. The first cutting was made in May, 1928, after a growing period of 80 days. The alfalfa yielded at the rate of 23 tons of green forage per acre. The variety appears to be a very promising addition to the alfalfas already being grown.

SWEET CLOVER

A trial planting of 13 varieties or strains of sweet clovers was made in November, 1927. Of these, S. P. I. No. 27465 (Agr. No. 2092), a semierect variety, appears to be the outstanding one, and is closely followed by F. C. No. 03917 (Agr. No. 2083). These clovers were sent to the station for sectional cultural tests by A. J. Pieters of the Office of Forage Crops Investigations, United States Department of Agriculture.

PIGEON PEAS

Eight distinct varieties of pigeon peas were collected in India and sent to the station by F. G. Krauss, collaborator of the station. These were planted, and records have been kept of their growth and

yield. Among them was a variety which appeared to be an annual. It bloomed when about 12 inches high, produced a crop of seed, and died.



FIGURE 8.—Left, stem of rice plant removed from (right) sheath, showing the presence of the rice borer, *Chilo simplex*, and the nature of the damage done by it.

BEANS

The Kentucky Wonder bean is considered the best pole variety for home and school gardens in Hawaii. Its prolificacy makes it the most popular local variety. Selective breeding of the Kentucky

Wonder bean has been under way at the station for the past three years. The object is to improve the general appearance of the pods and to increase further the productiveness by increasing the length



FIGURE 9.—Kentucky Wonder beans from selective breeding

of the pods. During the past year a single plant was noted to have produced pods 9 to 10 inches long. (Fig. 9.) The average length of the pods of the Kentucky Wonder bean is about 6 inches.

MELONS

The demand for information regarding the culture and relative merits of the various standard varieties of muskmelons and water-

melons has been almost constant from farmers interested in their culture. The agronomist secured seed of eight standard varieties of muskmelons and nine varieties of watermelons and distributed sample packets for cooperative variety tests to the different farmers who are interested in melon culture.

INSECT-REPELLING PLANTS

A trial planting was made of the insect-powder plant (*Pyrethrum roseum*) to learn its value in rotation with pineapples and the ability of the green manure when plowed under to act as a poison or repellent for nematodes. This plant was grown with difficulty on the heavy type of soil at the station, and a field test on one of the pineapple plantations is therefore being made.

LETTUCE BREEDING

An attempt is being made to develop lettuce plants which will head satisfactorily at the low altitudes in the Tropics. No positive results have thus far been obtained. Although over 1,000 hybrids were made from the heading varieties, only two crosses were found in the 1927-28 breeding work appearing to have the heading characteristics of the All Season and Mignonette varieties. The latter are standard varieties which have been found to be the best adapted to local conditions. Whether the heading qualities of the two hybrids are fixed or will fluctuate can not be definitely determined until further generations have been obtained. Possibly the increased vegetative vigor incident to the hybridizing may act as a deterrent to satisfactory heading. From observations made thus far, most of the hybrids show the characteristics of both parents except in the matter of heading.

POULTRY

The agronomist assisted in staging the poultry and pigeon shows at the sixth and seventh annual Territorial fairs. At the sixth fair, held August 29 to September 5, 1927, the poultry division exhibited both chickens and pigeons, and at the seventh fair, held April 30 to May 5, 1928, only pigeons. The 662 birds occupied two buildings. The agronomist also acted as a judge in the vegetable and field crops contest at the eleventh annual Maui County fair, and assisted in assembling the poultry and pigeon exhibits from Honolulu. In the latter part of the year he contributed a weekly article on poultry and pigeon topics to a local daily paper.

Judging from the keen interest now being taken by the local poultry fanciers in the industry, the standard of Hawaiian-bred poultry should be very high within a few years. This prediction is based on the interest continually manifested in the shipping of high-class hatching eggs direct from the mainland to the Territory. Now that it is possible to ship eggs from San Francisco to Hawaii in four and one-half days, hatching eggs 5 days old can be imported from San Francisco and 8 days old from the other cities along the Pacific coast via San Francisco. The agronomist advised intending importers of hatching eggs how to order and handle them. These eggs have shown percentages of hatchability ranging from 19 to 66.

REPORT OF THE CHEMICAL DIVISION

By J. C. RIPPERTON and C. RICHTER

EDIBLE CANNA INVESTIGATIONS

Investigations relating to the growth and culture of the edible canna and the properties and processes of the manufacture of its starches were continued.

NATURE OF THE GROWTH OF THE EDIBLE CANNA PLANT

A number of small experiments concerning the nature of the growth of the edible canna plant were completed.

By tagging of the newly developed stalks in each of a series of 40 hills the relationship of the number of stalks in the initial growth to the weight of the hill at harvest was determined. Except in sub-normal hills, the initial number of stalks was found to have little relationship to the ultimate size of hill.

A large number of genealogizations were averaged. These averages showed that after the third generation there is always a large excess of buds over the number which is able to develop in a normal hill. The vigor of the initial stalk growth rather than the number of stalks is probably therefore the important factor in determining the ultimate size of the hill.

A series of hills was harvested at the end of six months and the relationship between the seed piece and weight of the hill determined. The size of the hill was found to decrease with the size of the seed piece below a certain minimum weight. Above this minimum there is no certain correlation.

A series of hills at Waimea, Hawaii, was harvested at monthly intervals and the number of rootstocks having developed and undeveloped stalks (spikes) determined. For over a 6-month period the total number of stalks remained nearly constant, but the spikes increased regularly. This bears out the theory that only such proportion of rootstocks develop stalks as is required to maintain the optimum leaf area required by the plant, the remaining spikes functioning simply as storage organs.

A series of adjacent hills was harvested from fields at the central station, Honolulu, and at Waimea, Hawaii. At Waimea variation in the total weight of the various hills appeared to be a function of the total number of rootstocks rather than of the average weight. There was no definite correlation with the station hills. With respect to the difference in the hills from the two localities, the number of rootstocks per hill was nearly the same, but the average size per rootstock, and hence the total weight, at Waimea was outstandingly greater.

A series of hills at Waimea, Hawaii, and at the central station, Honolulu, was visited at monthly intervals, and the new stalks were tagged for a period of 12 months. These values when plotted showed very marked difference between the two locations: At Waimea very definite cycles of stalk development were apparent, which did not appear at the station. At Waimea the number of spikes was large, whereas at the station there were practically none. These differences are explained by the fact that at Waimea the optimum stalk develop-

ment is reached after a certain period. At the station adverse climatic conditions prevent this optimum development; hence the stalk of each new rootstock developed as soon as the rootstalk was formed.

FIELD EXPERIMENTS

In experiments with edible canna carried on in cooperation with the extension agent on Hawaii, the crop was harvested in the station's experimental field at Waimea. Of especial import was the slowness of germination of seed planted in November as compared with that of the August plantings. If this is borne out in subsequent experiments, seasonal planting would be necessitated rather than a regular schedule of planting and harvesting throughout the year. First harvest and second planting were made of the hill-selection experiments. Individual records of 216 hills used in this selection are to be kept over a period of three to five harvests, when selection of outstanding hills will be made.

In addition to the hill-selection experiment, further work was undertaken to determine the possibilities of selection, based on such characters as largeness of individual rootstock and vigor within an otherwise dormant hill. The experiments on seasonal plantings and harvestings were repeated, because definite knowledge on these two points is of fundamental importance in the establishment of edible canna starch industry.

Four experiments were begun on Oahu in cooperation with a local pineapple company, to determine the value of edible canna as a green-manuring crop in pineapple culture. In two of these experiments, located at Kunia and at Waipio, the crop was dug because of its apparent susceptibility to nematodes. The other two plats, at Pupukea and at Kaneohe, show very little nematode infestation thus far.

MANUFACTURING PROCESS

The chemist and the extension agent for the island of Hawaii spent seven weeks investigating the defects of the milling process in a starch factory at Waimea. A number of reports concerning the defects and recommended changes in the process were submitted to the company. The following are among the more important conclusions drawn: Mechanical defects result largely from the use of too much makeshift machinery. Although there is as yet no modern edible-canna starch-mill machinery, certain of the standard machines used in the manufacture of potato and cassava starches are adapted to edible-canna starch manufacture and could be used for the purpose. The chief difficulty in the process is the removal of the fine soil particles from the extracted starch. This can not be done by levigation or by fluming, because of the rapid settling of canna starch. It must be accomplished either by screening the starch milk, or by freeing the rootstocks from soil before they are shredded, or by both methods. Screens and washing machines used in the manufacture of other tuber starches will probably have to be modified somewhat for edible canna, to give satisfactory results. It is recommended that one machine of each of certain specified types appearing to be adapted to the process be ordered and set up temporarily,

and the process worked out step by step by means of small trial runs, beginning with washing the rootstocks and progressing through the shredding, extracting, screening, refining, and drying stages. With the satisfactory adaptation of each machine orders could be placed for the whole mill. In connection with the refining screens, a revolving screen was constructed which apparently eliminated all the difficulties encountered in the shaking screens now used in the process.

METHOD OF DETERMINING THE PROPERTIES OF STARCHES

Further tests with the viscosity method of determining the "strength" of a starch showed that the utmost precision is required to secure concordant results. While closely agreeing results can be obtained for a period of days, a slight difference in the method of procedure in the same laboratory is sufficient to give another series of results. This method was therefore discarded in favor of a method which was developed to measure the swelling power of the starch. The latter method, an adaptation of one proposed by Harrison,⁴ measures the volume of the granules of starch that has been previously cooked, poured into a cylinder containing distilled water, and allowed to settle. The swelling power of the starch is then expressed in terms of cubic centimeters of settled-starch mass per gram of oven-dry starch. This method is not only adapted to scientific investigations concerning the properties of starches, but is ideal for mill control since it requires simple, inexpensive apparatus and is simple in theory as well as in practice.

Investigation is now being made of the effect upon the swelling power of starch (1) of time and temperature of cooking, (2) of the various ions, (3) of nonelectrolytes, and (4) of hydrogen-ion concentration. Of special import is the relatively large effect of electrolytes in depressing the swelling power of edible-canna starch as compared with other starches. The addition of as little as 1 part per million of certain ions to a solution of the swollen granules of edible-canna starch causes a very appreciable shrinkage.

The effect on the swelling power of edible-canna starch of difference in climatic conditions and age of planting, storage of rootstocks and of wet starch, and variations in the milling procedure is being further studied.

STUDIES OF PHYSICAL PROPERTIES OF TROPICAL SOILS OF VOLCANIC ORIGIN

As a part of a general investigation of the physical properties of tropical soils of volcanic origin, work was begun on the soil colloids. Soil samples of typical uplands and beach agricultural lands and of unusual and extreme types have been collected. The apparatus has been assembled for dispersion, separation, and purification of the colloids. In connection with an investigation begun earlier, a number of soil samples from areas irrigated with brackish water have been included in the above-mentioned study to determine the specific effect of salt upon the soil colloids.

⁴ HARRISON, W. ON SOME PROPERTIES OF STARCH RELATING TO ITS STIFFENING POWER. *Jour. Soc. Dyers and Colourists*, 27: 84-88, illus. 1911.

PRESERVATION OF HAWAIIAN FRUITS

In connection with the practice of canning guave juice for use by local fruit-preserving concerns when the fresh fruit is out of season, it was found that while the flavor, color, and clarity of the jelly from the canned juice was excellent, the pectin content deteriorated to such an extent as to necessitate the addition of pectin to produce a jelly. Deterioration in pectin does not occur when the juice is stored in 1 to 2 quart containers, but occurs in that stored in 1 to 10 gallon containers, due probably to the longer time the larger quantities of juice hold the heat. Notwithstanding the deterioration, storing of the extracted juice is recommended because the addition of pectin adds only a nominal cost as compared with the value of the finished jelly.

REPORT OF HALEAKALA SUBSTATION AND DEMONSTRATION FARM

By H. F. WILLEY

The Haleakala substation and demonstration farm continued its work of determining the kinds of crops and cultural practices that are best adapted to the section in which it is located. Propagating material of the most desirable varieties was distributed to farmers throughout the island of Maui. Distributions were made of 1,600 pounds of edible-canna tubers, 600 strawberry plants, 6,500 cuttings of sweet potatoes, 1,000 cuttings of Uba cane, and 21 truck loads of Napier grass and Merker grass cuttings for planting on a large scale. Distributions in lesser quantities were made of pigeon peas, field and garden beans, tomato seed, pop corn, field corn, cassava, taro, vetch, rhubarb, and asparagus. Some 178 varieties of 70 species of crops were tested, including 23 varieties of taro, 18 varieties of fruit trees, 15 varieties of cultivated grasses, 12 varieties of sweet potatoes, 12 varieties of beans, 10 varieties of windbreak trees, 12 varieties of beans, and a smaller number of varieties of pigeon pea, purple vetch, sorghum. *Meibomia rensoni* (the barajillo of Salvador), alfilaria, Australian saltbush, cassava, edible canna, radish, carrot, beet, lettuce, onion, squash, pumpkin, cucumber, turnip, pepper, tomato, pea, kohlrabi, parsley, sage, asparagus, rhubarb, roselle, strawberry, pineapple, grape, blackberry including Logan, raspberry, dewberry, gooseberry, currant, peanut, field corn, pop corn, sweet corn, oats, barley, flax, wheat, rye, clover, watermelon, muskmelon, and field beans.

The superintendent devoted considerable of his time to the boys' and girls' 4-H club work and also assisted with the school-garden contests and the exhibits at the county and Territorial fairs. Eighty-one of the 4-H club members on Maui entered the Honolulu Star-Bulletin home-garden contest, and won nearly all the prizes. The superintendent also assisted the farmers in solving problems of production and marketing, served as a committeeman of the Maui Chamber of Commerce, and acted as agricultural representative and committeeman on public lands.

REPORT OF EXTENSION AND DEMONSTRATION WORK ON THE ISLAND OF HAWAII

By R. A. GOFF

The extension agent made trips as often and as regularly as possible to farmers and ranchmen in all parts of the island. He also gave advice regarding poultry and hog raising, dairying, market gardening, purchasing seed, combating crop pests and diseases, and the growing of improved grasses for cattle ranges. He prepared plans for livestock buildings and outlined methods of fruit-tree planting in orchards, and gave encouragement to the school and home-garden work carried on by pupils of the public schools.

EDIBLE CANNA

The manufacture of starch on a commercial scale from edible canna is a comparatively new industry. Problems are therefore constantly arising in connection with field practices, crop production, and milling. Considerable time was devoted to the crop in the Waimea district where there are nearly 100 homesteaders who are interested in the establishment of a starch industry, and it is possible to utilize some of the thousands of acres of land now devoted to grazing, for canna production. Field experiments dealing with tuber selection for planting, seasonal plantings to determine the effect on yield, the use of fertilizers, and a study of the canna-plant diseases, which have been in progress for several years, were continued. New machinery was installed in the hope of improving local manufacturing methods in the starch factory.

FARMERS' MEETINGS

Talks were given to interested groups of farmers in the homesteading districts on miscellaneous agricultural topics including feed production, marketing crops, poultry raising, fruit orchards, and vegetable gardens. Spraying demonstrations were given on methods of controlling weeds and garden and fruit-tree pests.

BOYS' AND GIRLS' CLUBS

Boys' and girls' club activities, including livestock clubs, gardening clubs, cooking clubs, and sewing clubs, were organized or continued in three districts of the island. Regular and special club meetings were held, at which plans were formulated, suggestions given, and record books and Farmers' Bulletins of the United States Department of Agriculture, distributed. Assistance was given in obtaining poultry and pig breeding stock and arranging payments for the same. Seed was distributed to club members wishing to plant crops to furnish feed for their livestock. Materials for the sewing clubs were secured and distributed. Exhibits of livestock and completed project work were made at a local fair as well as at the Territorial fair in Honolulu. The club delegates cooperated in demonstrational work and judging club exhibits at the Territorial fair.

MARKETING

Assistance was given to farmers in marketing their produce in Hilo and Honolulu by making arrangements with merchants for the handling of such commodities as fruit, including avocados and oranges,

poultry products, and corn and potatoes. Samples of improved packing boxes and containers for shipping fruit and vegetables were shown. Demonstrations of grading and properly packing for shipment were given, with a view to obtaining better prices for the producer.

DEMONSTRATION PLATS

Small plantings of pasture grasses and forage crops were maintained at schools in different parts of the island. The names of the different crops were placed on stakes in each plat to aid the pupils of the school and visiting parents in familiarizing themselves with the names of the crops that are best adapted to the several localities. Seed and cuttings from the plats were distributed to those wanting them.

KAMUELA GRASS PLATS

Plantings of 5 pasture grasses and 10 soiling crops are being maintained by the Parker ranch in the cooperative experimental plats previously planted by the extension agent in Kamuela. Seeds, cuttings, and roots are taken from Kamuela and distributed to ranchmen, dairymen, and homesteaders and to schools in other parts of the island. The distributions included *Exophorus unisetus*, *Panicum antidotale*, *Paspalum larranagai*, *P. notatum*, *Phalaris bulbosa*, carpet grass, Merker grass, Napier grass, Peruvian winter grass, Rhodes grass, tall fescue, Uba cane, pigeon peas, and sweet clover.

SCHOOL AND HOME GARDEN WORK

The extension agent acted as one of the judges in the school-garden-contests on the east side of the island. He visited the schools to give talks concerning methods of combating garden pests, and of planting seed, and the proper use of fertilizers. He also assisted the young people in purchasing seed, and gave a talk on seed selection and storage, marketing, and the use of cover crops. He visited the projects of the young gardeners and gave suggestions on methods of improving both gardens and record keeping. He also visited and acted as a judge of the home projects of the students working under the Smith-Hughes vocational education act in the junior and senior high schools in the Kona, Hamakua, North Hilo, and South Hilo districts. These projects are devoted to sugar-cane and coffee culture and to poultry, pig, and dairy-cattle raising. Each student was accompanied to his project and given suggestions as to methods of improving it and keeping record.

FAIRS

The extension agent assisted in securing and bringing the exhibits to and from the Territorial fair in Honolulu. He also acted as chairman of the committee which selected and conducted five delegates from the schools of the island of Hawaii to the Territorial fair. The delegates acted as representatives of their respective clubs and were chosen for outstanding work in cooking, sewing, poultry raising, vegetable gardening, and pig raising. Their expenses for the period were defrayed by the fair commissioners. In a fair held in the Hamakua district at the Honokaa junior high school in May, 1928, the extension agent acted as a judge of the exhibits displayed by the agricultural, home economics, and shop classes.

ASSISTANCE IN BOY SCOUT ACTIVITIES

The extension agent continued to serve as special examiner for boys qualifying for agricultural merit badges throughout the year and as scout commissioner and member of the traveling court of honor for a part of the year.

PLANTING WINDBREAKS

Seedling trees of eucalyptus, ironwood (*Casuarina* sp.), Monterey cypress, and black wattle (*Acacia decurrens*), grown at the Hilo nursery of the Territorial board of agriculture and forestry, were distributed to farmers living in the Hamakua, Waimea, and Kau districts. The high winds which blow almost constantly across these sections of the island constitute the worst drawback to the cultivation of diversified crops there. Growth is checked and the plants are weakened to such an extent as to make them susceptible to the attacks of pests and diseases. Vegetable gardeners and corn and potato growers find it profitable to devote a part of their lands to the planting of windbreak trees in parallel rows from 250 to 300 feet apart.

ASSISTANCE IN PLANTING FRUIT TREES

Citrus and avocado seedlings were budded with bud wood from the best locally grown trees, many of which were originally introduced into Hawaii. The budded trees were distributed to farmers in different parts of the island. Seedlings which had been started by homesteaders were budded and topworked on the farms where they are to remain permanently. The extension agent cooperated with agricultural instructors of the high schools by conducting demonstrations in budding and grafting and by securing material and choice wood from the better trees of the island. Papaya seed and banana suckers were given to interested private growers.

DISTRIBUTION OF SEED

Pigeon-pea seed was secured from the island of Maui and distributed to cattle ranchmen on the island of Hawaii for use in improving pasture and range lands. Corn seed was taken from the corn districts of Waimea and Kohala and distributed to schools and farms on the east side of the island. Cuttings and roots of the pasture grasses and forage crops that are maintained in the Kamuela grass plats were distributed to dairymen and homesteaders requesting them. Cuttings were also secured from the station in Honolulu for farmers in Hawaii. A supply of seed catalogues was distributed on field trips, and seed was purchased for farmers wishing to order new varieties from mainland seed houses.

DISTRIBUTION OF LITERATURE

Bulletins and circulars published by the station and the United States Department of Agriculture were distributed to farmers and schools in different parts of the island. Magazines and newspapers containing interesting articles on agricultural topics were loaned to farmers and to schools. Supplies of station bulletins and of

Farmers' Bulletins of the United States Department of Agriculture were loaned to agricultural instructors in the high schools for classroom work, and assistance was given in securing supplies for the teachers.

COFFEE

A further study of the coffee industry was made in response to requests from local growers for governmental assistance. A general survey of the coffee-growing areas was made, and the problems of coffee growers were ascertained through a number of personal interviews. Methods of coffee culture practiced by growers in other countries were studied to permit comparison with local methods and to determine the advisability of establishing cooperative experiments with growers.

REPORT OF BOYS' AND GIRLS' CLUB WORK

By MABEL GREENE

STANDARD CLUBS

Boys' and girls' 4-H clubs were organized on the islands of Kauai, Oahu, Maui, and Hawaii. Four new club communities were added in Oahu. Activities among the 4-H club members in Maui increased, due to improved follow-up work.

The distribution of the boys' and girls' 4-H standard clubs of the islands is shown in Table 1.

TABLE 1.—*Enrollment of boys' and girls' clubs June 30, 1928*

Club	Oahu	Maui	Hawaii	Kauai	Total
Food preservation.....	26	38	-----	-----	64
Bread.....	15	20	19	-----	54
Cooking.....	332	92	173	34	631
Clothing.....	84	112	32	14	242
Garden.....	6	54	-----	-----	60
Pig.....	30	80	7	-----	117
Poultry.....	-----	33	1	-----	34
Rabbit.....	7	-----	-----	-----	7
Horticulture.....	-----	-----	-----	-----	-----

Club activities were conducted in cooperation with the public schools with the teachers largely acting as leaders. Many of the clubs held meetings during the school season. In a few instances club leadership was not under school supervision. In Haiku, Maui, a pig club of 15 members had as leader Richard S. Gima, a 3-year 4-H pig-club member. In Makawao, Maui, Mrs. H. F. Willey conducted a very successful combined cooking and clothing club. In Honolulu, Maisie Leong, with a 5-year record as a 4-H club member, is leader of 15 girls in a cooking and food-preservation club that meets weekly during the summer and monthly during the school season. (Fig. 10.) The other clubs met every two weeks. The club leader assisted girl scouts who are interested in canning and food-preservation work. Two 4-H clubs were organized by two groups of girls in this work. Several of the girls were awarded canners' badges.

FAIRS AND DEMONSTRATIONS

The Territorial fairs were held from August 29 to September 5, 1927, and from April 30 to May 5, 1928. Committee activities, the training of demonstration teams for the fairs, caring for visiting delegates from the outlying islands, and preparing club exhibits added zest to club interests. Nine successful interisland 4-H club contestants attended the fall Territorial fair. The interisland members participated in gardening, poultry, canning, clothing, and bread-making contests. (Fig. 11.) A demonstration in making guava jelly and guavalets (guava candy) was given by a team of 4-H club girls. At the spring Territorial fair the junior branch was one of the more important features. The club leader acted as chairman of the home economics division and looked after the welfare of 14 visiting girl



FIGURE 10.—Alice Young and Maisie Leong. Pollyana 4-H club team

delegates forming part of the delegation of 31 boys and girls participating from the various islands and from Oahu. The visit of Miss Madge Reese of the United States Department of Agriculture in charge of boys' and girls' club work in the Western States, stimulated interest in fair activities. The judging of the junior-fair home economics exhibits was placed under her supervision. Demonstrations were given in boning and preparing chickens for roasting, "good buymanship," and grading eggs for market.

Under arrangements made by the Territorial fair commissioners, two 4-H club boys from rural Oahu entered heifer calves for exhibit at the junior Territorial fair. The boys camped on the fairground, cared for their animals, and enjoyed the educational program provided for visiting delegates from the various islands. Seichi Tamura, a member of the Kuhio pig club, of Honolulu, was awarded a silver cup for entering the best pig for exhibit in the junior Territorial fair. (Fig. 12.) The pig is one of the two registered Tam-



FIGURE 11.—Boys' and girls' 4-H club representatives from the other islands. Miss Greene and Mr. Willey, back row, right

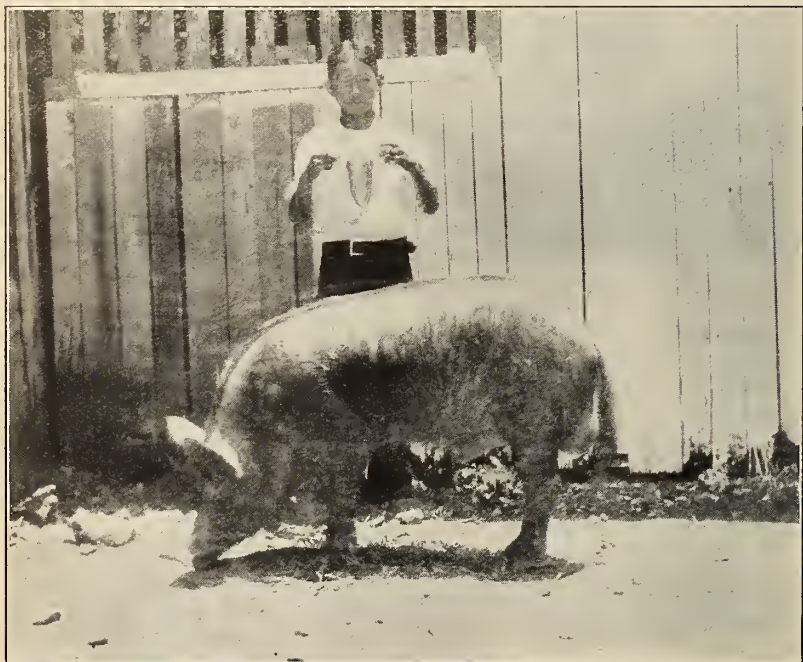


FIGURE 12.—Seichi Tamura, Kuhio pig club member, awarded the silver cup for the best pig

worth boars that were purchased this year from the University of Hawaii farm. A silver cup was awarded a 4-H club boy for the best work in swine judging at the same fair. The 4-H clubs also had representatives in the poultry-judging contest at the fair. (Fig.



FIGURE 13.—Poultry club members grading eggs

13.) Much interest was shown in "Mrs. Ever-Well's medicine chest" displayed by the station. This exhibit was designed to encourage the use of more fruits and vegetables in the diet. Improved programs intensified interest in club work and prepared the way for larger community programs in the future.

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